

WHAT IS CLAIMED IS:

1. A vehicular steering control device comprising:
an input portion coupled to a steering wheel that is operated by a driver;
5 an output portion drivingly connected to steered wheels;
a steering transmission ratio change device that changes a steering transmission ratio by causing the input portion and the output portion to rotate relative to each other by an actuator that rotationally operates in association with the steering wheel;
an electric connection mechanism that supplies the actuator with electric power
10 from an external side; and
a restriction device that sets a restricted relative rotational angle to be created by the actuator in one lateral direction equal to or smaller than a difference between a permissible rotational angle to be defined by the electric connection mechanism in the other lateral direction and a maximum possible rotational angle of the output portion
15 in the other lateral direction, and controls a relative rotational angle to be created by the actuator in said one lateral direction to an angle equal to or smaller than the restricted relative rotational angle.
2. The steering control device according to claim 1, wherein the actuator has a
20 stator coupled to one of the input and output portions and a rotor coupled to the other of the input and output portions.
3. The steering control device according to claim 1, wherein the actuator is an
25 electric motor.
4. The steering control device according to claim 3, wherein the electric motor is coupled at the stator to the input portion and at the rotor to the output portion.
5. The steering control device according to claim 1, wherein the restriction
30 device sets a magnitude of a target relative rotational angle to be created by the actuator equal to or smaller than a magnitude of the restricted relative rotational angle.
6. The steering control device according to claim 5, wherein the restriction
35 device sets a target relative rotational angle to be created by the actuator as an angle whose magnitude is smaller than a restricted relative rotational angle.

7. The steering control device according to claim 1, wherein the restriction device inhibits an amount of relative rotation of the input and output portions from increasing or decreasing if a magnitude of a relative rotational angle to be created by the actuator becomes equal to or larger than a magnitude of the restricted relative rotational angle.

8. The steering control device according to claim 7, wherein the restriction device prevents the input and output portions from rotating relative to each other if a magnitude of a relative rotational angle to be created by the actuator becomes equal to or larger than a magnitude of a restricted relative rotational angle.

9. The steering control device according to claim 7, wherein the restriction device inhibits the amount of relative rotation from increasing or decreasing by causing the input and output portions to rotate integrally, and reduces a rotational output of the actuator.

10. The steering control device according to claim 9, wherein the restriction device reduces a rotational output of the actuator to 0 when the rotational output of the actuator is to be reduced.

11. The steering control device according to claim 1, wherein the restriction device inhibits an amount of relative rotation of the input and output portions from increasing or decreasing if a magnitude of a relative rotational angle to be created by the actuator becomes equal to or larger than a predetermined value that is smaller than a magnitude of the restricted relative rotational angle.

12. The steering control device according to claim 11, wherein the restriction device prevents the input and output portions from rotating relative to each other if a magnitude of a relative rotational angle to be created by the actuator becomes equal to or larger than a predetermined value that is smaller than a magnitude of a restricted relative rotational angle.

13. The steering control device according to claim 11, wherein the restriction device inhibits the amount of relative rotation from increasing or decreasing by

causing the input and output portions to rotate integrally, and reduces a rotational output of the actuator.

14. The steering control device according to claim 13, wherein the restriction
5 device reduces a rotational output of the actuator to 0 when a rotational output of the actuator is to be reduced.

15. The steering control device according to claim 1, wherein the restriction
10 device sets a restricted relative rotational angle as an angle whose magnitude is smaller than a difference between a permissible rotational angle to be defined by the electric connection mechanism in the other lateral direction and a maximum possible rotational angle of the output portion in the other lateral direction, and controls a
15 magnitude of a relative rotational angle to be created by the actuator in said one lateral direction to a value equal to or smaller than a magnitude of the restricted relative rotational angle.

16. The steering control device according to claim 1, wherein the electric
connection mechanism has an outer power supply member fixed to a vehicle body, an
inner power supply member fixed to the input portion or the output portion, and a
20 flexible spiral cable that spirally extends around the inner power supply member and that contains conductor wires for connecting the outer power supply member with the actuator.

17. The steering control device according to claim 16, wherein the permissible
25 rotational angle to be defined by the electric connection mechanism in the other lateral direction is a permissible rotational angle that is defined in the other lateral direction by a length of the spiral cable, an inner diameter of the outer power supply member, and an outer diameter of the inner power supply member.

18. The steering control device according to claim 1, wherein the output portion is
30 drivingly connected to the steered wheels via a steering mechanism, and
wherein the maximum possible rotational angle of the output portion in the other lateral direction is a maximum possible rotational angle that is defined by a turnable range of the steered wheels or an operable range of the steering mechanism.

19. A control method for a vehicular steering device having an input portion coupled to a steering wheel that is operated by a driver, an output portion drivingly connected to steered wheels, a steering transmission ratio change device that changes a steering transmission ratio by causing the input portion and the output portion to rotate relative to each other by an actuator that rotationally operates in association with the steering wheel, and an electric connection mechanism that supplies the actuator with electric power from an external side, the control method comprising the steps of:

setting a restricted relative rotational angle to be created by the actuator in one lateral direction equal to or smaller than a difference between a permissible rotational angle to be defined by the electric connection mechanism in the other lateral direction and a maximum possible rotational angle of the output portion in the other lateral direction; and

controlling a relative rotational angle to be created by the actuator in said one lateral direction to an angle equal to or smaller than the restricted relative rotational angle.